

CLAIMS

What is claimed is:

1. A method comprising:

receiving an input data stream at a first bit rate;

performing a first domain transformation of the input data stream; and

encoding the input data stream into a plurality of output data streams having a plurality of bit rates by utilizing the first domain transformation of the input data stream.

2. The method according to claim 1, wherein the input data stream is a plurality of video frames.

3. The method according to claim 2, wherein the receiving, performing, and encoding of the video frames is done on a frame-by-frame basis.

4. The method according to claim 3, wherein the encoding for a first video frame is completed for the plurality of output data streams before the encoding for a second video frame is started.

5. The method according to claim 2, wherein performing the domain transformation of the input data stream is performed once for each video frame.

6. An apparatus for generating a plurality of multi-rate encoded video streams comprising:
Patent Application

a domain transform stage, having a signal input and a transform output, wherein the signal input is coupled to receive an input stream of video frames;

a motion estimation stage, having a first input, a second input, a third input, a fourth input, and an output, wherein the first input is coupled to receive the input stream, the second input is coupled to receive a prior video frame, the third input is coupled to receive the transform output, the fourth input is coupled to receive a prior transformed video frame, and the output is motion vector data;

a first encoder stage, having a first input, a second input, a first output, and a second output, wherein the first input is coupled to receive the transform output, the second input is coupled to receive the motion vector data, the first output is first coefficient data, and the second output is a delayed first encoder stage signal; and

a plurality of subsequently cascaded encoder stages each having a first input, a second input, a third input, a first output, and a second output, wherein the first input is coupled to receive the transform output, the second input is coupled to receive the motion vector data, the third input is coupled to receive a prior encoder stage delayed signal, the first output is coefficient data for that stage, and the second output is a delayed encoder signal for that stage.

7. The apparatus of claim 6 wherein the encoded video streams are generated frame by frame.

8. The apparatus of claim 6 wherein the transform stage further comprises:

a discrete cosine transform.

9. The apparatus of claim 6 wherein the motion estimation stage further comprises:
 - an entropy coder with an input and an output, wherein the input is coupled to receive the motion vector data, and the output is entropy coded motion vector data.
10. The apparatus of claim 9 wherein the motion vector data is generated only once for each video frame.
11. A machine-readable medium having stored thereon instructions, which when executed by a processor, causes said processor to perform the following:
 - receive an input data stream at a first bit rate;
 - perform a first domain transformation of the input data stream; and
 - encode the input data stream into a plurality of output data streams having a plurality of bit rates by utilizing the first domain transformation of the input data stream.
12. The machine-readable medium according to claim 11 wherein receiving the input data stream is receiving a plurality of video frames.
13. The machine-readable medium according to claim 12 wherein performing the first domain transformation is performed only once for each video frame.
14. A system comprising:
 - a multi-rate encoder having an input and a plurality of outputs, wherein the input is

connected to a video input stream; and

a plurality of receivers having inputs, wherein the inputs are coupled to receive the multi-rate encoder plurality of outputs.

15. The system of claim 14, wherein the multi-rate encoder encodes the video input stream frame by frame.

16. The system of claim 15, wherein the multi-rate encoder encodes the plurality of outputs for a first frame before encoding the plurality of outputs for a second frame.

17. An apparatus comprising:

a domain transformation block having an input and an output, the input coupled to receive an input data stream at a first bit rate, and the domain transformation block generating a transformation on the output;

a motion estimation block having a plurality of inputs and outputs, the inputs coupled to receive the input data stream at the first bit rate and the transformation, and the motion estimation block generating a motion vector and an entropy coded motion vector on the outputs; and

a plurality of bit rate encoding blocks having a plurality of inputs and outputs, the inputs coupled to receive the transformation and the motion vector, and the outputs generating entropy coded coefficient data at a plurality of bit rates.

18. The apparatus of claim 17, wherein the plurality of bit rate encoding blocks outputs

further comprises predicted data and delayed compensated predicted data.

19. The apparatus of claim 18, wherein the plurality of bit rate encoding blocks inputs are further coupled to receive said predicted data and said delayed compensated predicted data.

20. The apparatus of claim 18, where the input data stream is a plurality of video frames and wherein the transformation is performed only once for each video frame.

21. An apparatus comprising:

means for receiving an input data stream at a first bit rate;
means for performing a first domain transformation of the input data stream; and
means for encoding the input data stream into a plurality of output data streams having a plurality of bit rates by utilizing the first domain transformation of the input data stream.

22. The apparatus of claim 21, wherein means for receiving input data is a means for receiving a plurality of input video frames.

23. The apparatus of claim 22, wherein transforming the input data is performed only once for each input video frame.

24. A method comprising:

inputting data;

transforming the data;

subtracting the transformed data and a first stage transformed predicted data to obtain a first stage difference;

quantizing the first stage difference;

receiving the first stage quantized difference into a first stage entropy coder;

outputting first coefficient data from the first stage entropy coder;

de-quantizing the first stage quantized difference;

summing the first stage de-quantized difference and the first stage transformed predicted data to obtain a first stage summation result;

delaying the first stage summation result;

creating the first stage transformed predicted data by combining motion vector data and the delayed first stage summation result;

creating the motion vector data by combining the data, a prior version of the data, the first stage transformed data, and the delayed first stage summation result;

receiving the motion vector data into a second entropy coder;

outputting motion vector entropy coded data from the second entropy coder;

(a) inputting the transformed data into stage N;

(b) subtracting the transformed data and a stage N transformed predicted data to obtain a stage N difference;

(c) quantizing the stage N difference;

(d) receiving the stage N quantized difference into a stage N entropy coder;

(e) outputting stage N coefficient data from the stage N entropy coder;

- (f) de-quantizing the stage N quantized difference;
- (g) summing the stage N de-quantized difference and the stage N transformed predicted data to obtain a stage N summation result;
- (h) delaying the stage N summation result;
- (i) creating the stage N transformed predicted data by combining the motion vector data, a delayed stage M summation, and a stage M transformed predicted data;
- (j) repeating the sequence (a)-(i) K-1 times for K streams of encoding.

25. The method of claim 24 wherein M is less than N.

26. The method of claim 24 wherein the data is a plurality of video frames.

27. The method of claim 26 wherein transforming the data is performed only once for each video frame.

28. The method of claim 27 wherein transforming the data comprises performing a discrete cosine transform on the data.

29. The method of claim 26 wherein the motion vector data is generated only once for each video frame.

30. An apparatus comprising:

a first block for receiving an input data stream at a first bit rate;
a second block for performing a first domain transformation of the input data stream;
and
a third block for encoding the input data stream into a plurality of output data streams having a plurality of bit rates by utilizing the first domain transformation of the input data stream.

31. The apparatus of claim 30, wherein the first block for receiving input data is receiving a plurality of input video frames.
32. The apparatus of claim 31, wherein transforming the input data is performed only once for each input video frame.